REMARKS

In order to expedite the prosecution of the present application, Claim 1 has been amended to state that the water-soluble nitrogen-containing polymer is present in an amount of 0.0001-5 g/L, the glyoxylic acid is contained in an amount of 0.005-0.5 mol/L and phosphinic acid contained in an amount of 0.001-0.5 mol/L in the electroless copper plating solution. Newly presented Claims 8 and 9 are directed to preferred embodiments of the present invention. No new matter has been added.

Claims 1-3, 5 and 6 have been rejected under 35 USC 103(a) as being unpatentable over Amelio et al in view of Verbunt. Claims 1-3, 5 and 6 have also been rejected under 35 USC 103(a) as being unpatentable over Amelio et al in view of Verbunt, Kondo et al and Yoshida et al. Claims 1, 2, 5 and 6 have been rejected under 35 USC 103(a) as being unpatentable over Shipley, Jr. et al in view of Verbunt, Kondo et al and Yoshida et al. Claim 3 has been rejected under 35 USC 103(a) as being unpatentable over Shipley in view of Verbunt, Kondo and Yoshida and further in view of Amelio et al. Claims 1-3, 5 and 7 have been rejected under 35 USC 103(a) as being unpatentable over JP '779 in view of Verbunt. Claims 1-3, 5 and 6 have been provisionally rejected on the ground of nonstatutory obviousness-type double patenting over Claims 5 and 6 of application Serial No. 10/576 230 in view of Amelio et al. Claims 1-3, 5 and 7 have been provisionally rejected on the ground of nonstatutory obviousness-type double patenting over Claims 5 and 6 of application Serial No. 10/576 230 in view of JP '779. Claims 1, 2, 5 and 7 have been provisionally rejected on the ground of nonstatutory obviousness-type double patenting over Claims 1-3 of application Serial No. 12/075 745. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to an electroless copper plating solution which contains a water-soluble nitrogen-containing polymer and glyoxylic acid and phosphinic acid as reducing agents. The concentration of the water-soluble nitrogen-containing polymer is 0.0001-5 g/L, the concentration of glyoxylic acid is 0.005-0.5 mol/L and the concentration of phosphinic acid is 0.001-0.5 mol/L. The presently claimed invention also is directed to an electroless copper plating method which comprises performing the electroless copper plating with the electroless copper plating solution of the present invention.

The present invention is based on the discovery that when a water-soluble nitrogen-containing polymer is added to an electroless copper plating solution containing phosphinic acid and glyoxylic acid as reducing agents, the initial plating reactivity through the catalyst metal is higher which enables the provision of a uniform plating at lower temperatures on a semiconductor or other mirrored-surface substrate. This enables the plating deposition speed to be reduced, the crystals become finer and the adhesion of the plating to a wafer or other mirrored-surface substrate increase. It is respectfully submitted that the presently claimed invention is patentably distinguishable over the prior art cited by the Examiner.

All of the rejections made by the Examiner are either rejections under 35 USC 103(a) or obviousness-type double patenting rejections. Therefore, evidence of unobviousness such as unexpectedly superior results associated with the presently claimed invention can successfully rebut these rejections. Applicants respectfully submit that in light of the amendments to the claims and evidence contained in the present specification, the presently claimed invention is patentably distinguishable over the prior art cited by the Examiner.

The currently presented claims now require specific amounts of the polymer, glyoxylic acid and phosphinic acid and

therefore correspond more closely to the showings of unobviousness presented in the Examples contained in the present specification.

As admitted by the Examiner, the Amelio reference does not teach a reducing agent made from both glyoxylic acid and phosphinic acid and the precise molecular weight and Mw/Mn ratio of the present claims. To cure these deficiencies, the Verbunt reference was cited but, as pointed out previously, the Verbunt reference does not disclose the presence of a water-soluble nitrogen-containing polymer in the plating solution.

The Kondo et al reference has been cited by the Examiner as teaching that when providing electroless copper plating solutions, a hypophosphite can be provided with a formalin reducing agent to allow a reduction in the amount of formalin used and accelerate a plating reaction when used with triethanolamine-containing baths.

The Yoshida et al reference has been cited by the Examiner as teaching that glyoxylic acid is a known replacement for formalin as a reducing agent in electroless copper plating but that glyoxylic acid plating proceeds slower than that of a plating solution containing formalin.

The Shipley, Jr. et al reference has been cited by the Examiner as teaching an electroless copper plating solution which contains a water-soluble nitrogen-containing polymer and a reducing agent of formaldehyde.

JP '779 has been cited by the Examiner as teaching an electroless copper plating solution containing a water-soluble nitrogen-containing polymer and a reducing agent, such as hydrazine. As admitted by the Examiner, this reference does not teach that the reducing agent is made from glyoxylic acid and phosphinic acid, the precise molecular weight and Mw/Mn ratio and the actual plating.

Claims 1-3, 5 and 7 of copending application Serial No. 10/576 230 are said to disclose an electroless plating method utilizing an electroless copper plating solution provided with

glyoxylic acid and hypophosphorus acid as reducing agents. However, as admitted by the Examiner, this reference does not teach a water-soluble nitrogen-containing polymer being used in the plating solution.

Claims 1-3 of application Serial No. 12/075 745 disclose an electroless plating solution containing a water-soluble nitrogen-containing polymer and glyoxylic acid and phosphinic acid as a reducing agent. However, as discussed above, all of the rejections made by the Examiner can be rebutted by showings of unobviousness of the presently claimed invention such as unexpected results. Once again, it is respectfully submitted that such evidence of unobviousness is of record in the present application.

In the bath composition disclosed in Verbunt, glyoxylic acid and phosphinic acid are used as reducing agents. No water-soluble nitrogen-containing polymer is added. This is similar to the bath composition of Comparative Example 1 of the present specification. In Comparative Example 1, glyoxylic acid and phosphinic acid are used as reducing agents and a water-soluble nitrogen-containing polymer is not added. The plating film formed using the plating bath of Comparative Example 1 was found to have problems such as peeling, poor adhesion and the trench portions of the film not being fully embedded.

The bath composition disclosed in JP '779 contains formalin as a reducing agent and polyethyleneimine as a water-soluble nitrogen-containing polymer. This is similar to that for Example 5 of the present specification. However, the plating film formed using this plating bath was found to be deposited in little islands and many portions without deposition were observed.

The bath composition of Example 4 is similar to that of Amelio et al. Example 4 shows the results of a bath containing glyoxylic acid and polyacrylamide but not including phosphinic acid. Amelio teaches the use of formaldehyde as a reducing agent and a polyacrylamide in the plating solution.

However, as formaldehyde is well known to have characteristics similar to glyoxylic acid, Example 4 is considered to be equivalent to Amelio's plating bath. The plating film formed using the bath composition of Example 4 was deposited in little islands and many portions without deposition were observed.

Unlike JP '779 and Example 4 of the present specification, both glyoxylic acid and phosphinic acid are required to be present in the specified amounts in the presently claimed electroless copper plating solution. As is seen by comparison of Example 4 with the Examples of the invention that fall within the scope of the present claims, superior results are obtained when both the phosphinic acid and glyoxylic acid are used as reducing agents. Therefore, Example 4 further points out the patentability of the presently claimed invention.

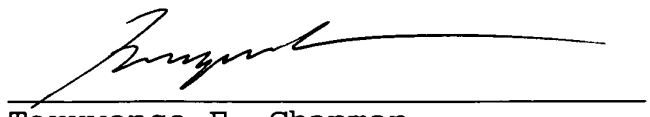
The embodiment of Example 5 of the present specification is similar to that for JP '779 and the bath composition of Example 5 produced poor plating results as compared to the examples corresponding to the currently claimed invention. The bath composition of Verbunt using glyoxylic acid and phosphinic acid as reducing agents with no water-soluble nitrogen-containing polymer was shown to be similar to that for Comparative Example 1, and the plating film formed therein had problems. Accordingly, there is no reasonable expectation of the superior properties of the present invention of improved adhesive strength and uniformity of the plating and reactivity at lower temperature by applying the combination of the reducing agents taught in Verbunt's bath composition to JP '779's bath composition comprising polyethyleneimine as a water-soluble nitrogen-containing polymer.

With respect to the Examiner's response to the arguments regarding JP '779 and its use of hydrazine, as pointed out by the Examiner, the references have shown that hydrazine is equivalent to glyoxylic acid, phosphinic acid or other

reducing agents and does not suggest that any advantage would be gained by using one reducing agent over the other.

Reconsideration of the present application and the passing of it to issue is respectfully solicited.

Respectfully submitted,



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